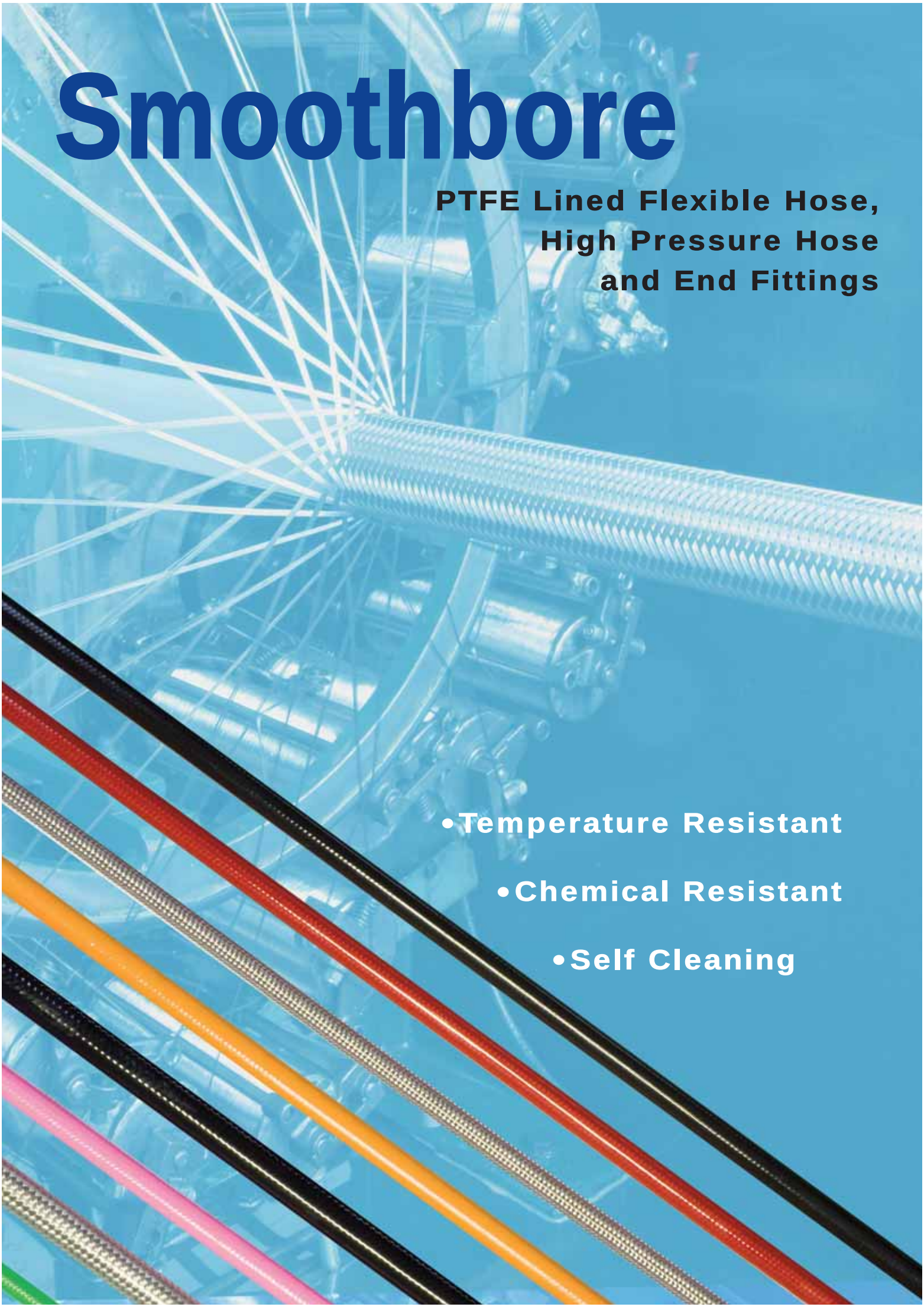
Smoothbore

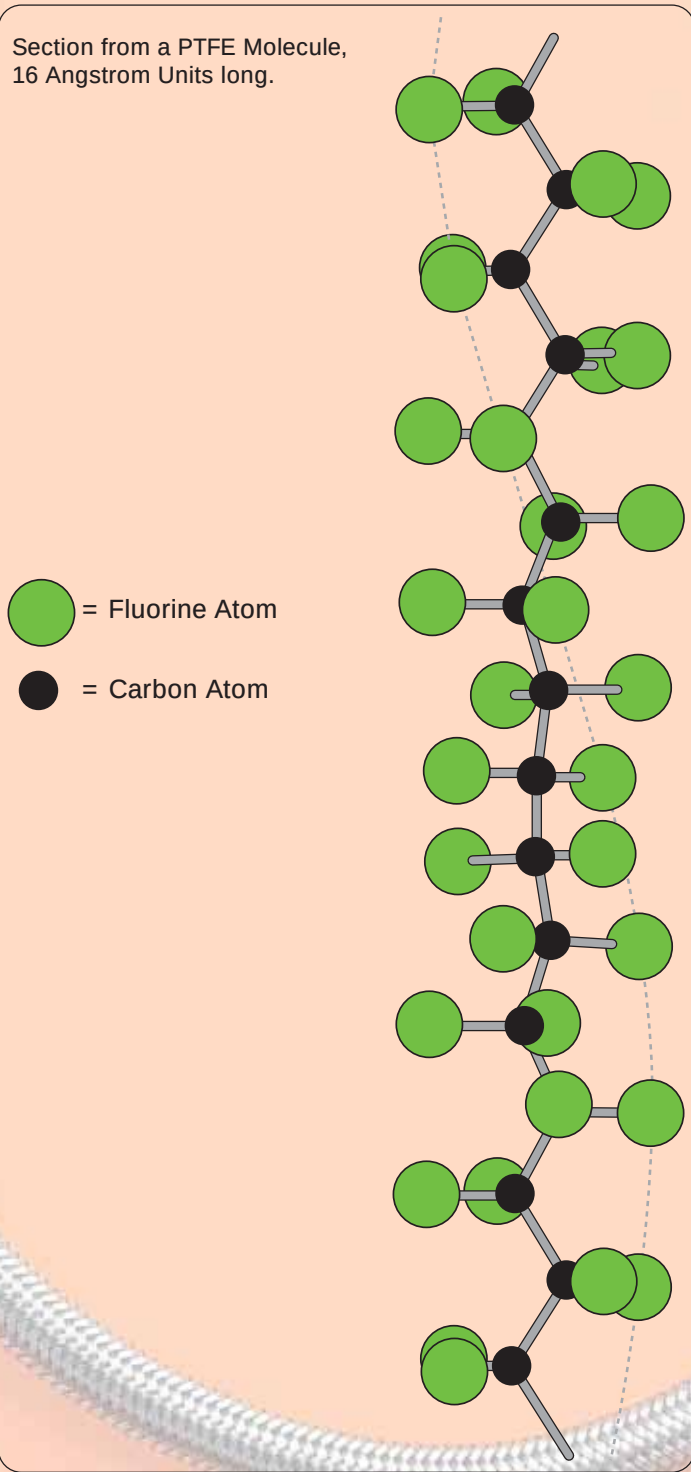
PTFE Lined Flexible Hose, High Pressure Hose and End Fittings



- Temperature Resistant
- Chemical Resistant
- Self Cleaning

PTFE - The Optimum Choice For Hose Linings

Section from a PTFE Molecule, 16 Angstrom Units long.



= Fluorine Atom

= Carbon Atom

PTFE, or Polytetrafluoroethylene, comprises long-chain molecules of carbon atoms, each linked to two fluorine atoms.

The fluorine atoms provide a helical spiral which surrounds the carbon chain and protects it.

It is this structure which creates the unique properties for which PTFE is well-known.

Excellent Chemical Resistance

PTFE is renowned as the most chemically resistant material known. Only a very few, very unusual substances and conditions can affect it, like Fluorine gas at high temperature and pressure and Liquid, boiling sodium metal.

PTFE lined hoses can therefore be used for a wider variety of chemicals than any other hose type, making it the ideal choice for very corrosive chemical applications and multi-product applications.

Non-Stick Surface

The use of PTFE as a surface for cookware products has demonstrated to the world how easily cleanable PTFE surfaces are.

This means that PTFE lined hoses can be purged 100% clean more quickly, easily and reliably than any other type of hose.

Excellent Temperature Range

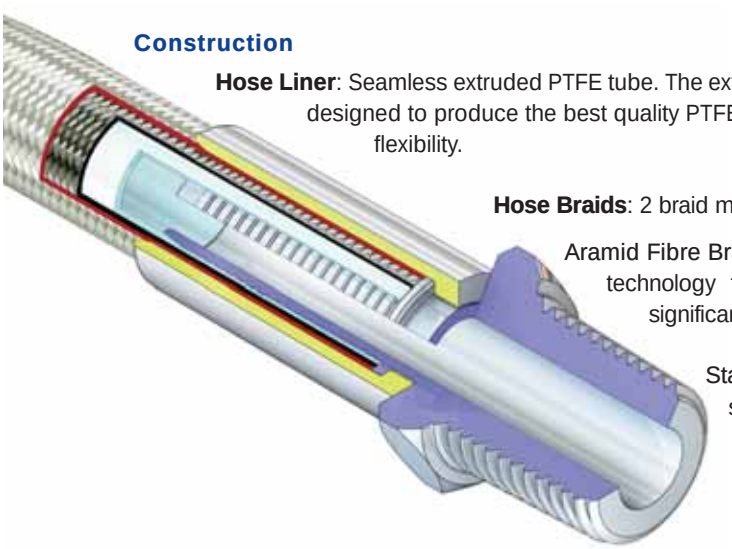
The cookware application also demonstrates another of PTFE's many attributes - temperature resistance. PTFE itself can be used as a hose liner at temperatures from -150˚C up to +260˚C, dependent upon the hose design and the application conditions.

This is the widest temperature range of any rubber or plastic hose lining material.

Hose Design

The only issue with PTFE as a hose lining material is the best way it can be integrated in to the hose design. This is where ZHflex Hose have a proven record of success over the last 30 years.

High Pressure Smoothbore Hose Grades



Construction

Hose Liner: Seamless extruded PTFE tube. The extrusion, heat treatment and quality control programmes are designed to produce the best quality PTFE tube possible, ensuring minimum porosity and maximum flexibility.

Hose Braids: 2 braid materials are utilised:

Aramid Fibre Braid - a black aramid fibre named “Tecnora”, which is a high technology fibre, with tensile, abrasion and temperature properties significantly better than the older Aramid products like Kevlar.

Stainless Steel Braid - Braided from AISI grade 304 stainless steel wire, bright hard drawn to a minimum 1700 N/mm2 tensile strength. The braiding process is closely controlled to ensure even tensions and the correct braid angle, to give minimum expansion/contraction under pressure.

GRADES AVAILABLE, and APPLICATIONS

There are 2 basic High Pressure hose grades:

GRADE HI - High Pressure Hose (also known as “Hiburst” Hose)

Construction - a single aramid fibre braid,
with a standard SS wire outer braid.

Size Range and Specifications

- Listed for some sizes on Page 8.
- Available to *Special Order in bore sizes from 1/8” (-3) up to 1” (-16)

Limitations

Suitable for use with fluids.
If use with gases at pressures above 100 bar (1500psi) is required, consult ZH-flex Hose for advice.

GRADE VHI - Very High Pressure Hose

Construction - 2 aramid fibre braids, with a special “Multi Pack” SS wire outer braid.

Size Range and Specifications

- Listed for some sizes on Page 8.
- Available to *Special Order in bore sizes from 1/8” (-3) up to 1” (-16)

Note: It is recommended that VHI hose tube liners should always be Heavy Wall (HW) grade.

Limitations

Suitable for use with fluids.
If use with gases at pressures above 100 bar (1500psi) is required, consult Aflex Hose for advice.

*AVAILABILITY

HI and VHI hose grades can be supplied to Special Order in any bore size, tube wall thickness and PTFE liner tube type as listed in this brochure.

Set-up and/or tooling charges will be applied to orders for small or medium quantities of hose specifications which are not available ex stock.

VHI Hose is not useable with standard end fittings and can only be assembled with Aflex’s specially designed VHI end fittings and ferrule (see page 11).

Please consult Aflex Hose for advice.

Specifications for High Pressure Hose Grades

SPECIFICATIONS and SIZE RANGE FOR HIGH PRESSURE HOSE (GRADE HI)

*Part No.	Aflex Nominal Bore Size and 'dash' reference	Grade	Actual Bore Size		PTFE Tube Wall Thickness		Outside Diameter of Braid		Maximum Working Pressure (4:1 Safety)		Burst Pressure		Minimum Bend Radius		Weight per Metre	
			ins	mm	ins	mm	ins	mm	psi	bar	psi	bar	ins	mm	lbs per foot	kgs per metre
70-300-04-03-02	3/16 BB -4	MW, HI	.200	5.08	.030	.76	.354	8.99	5,500	380	21,800	1,500	1.57	39.87	.140	.21
70-300-07-03-02	7/32	MW, HI	.220	5.58	.030	.76	.375	9.52	5,000	340	20,000	1,380	1.68	42.67	.145	.22
70-300-06-03-02	5/16 -6	MW, HI	.315	8.00	.030	.76	.486	12.34	4,700	320	18,900	1,300	1.75	44.45	.160	.24
70-300-08-03-02	3/8 BB -8	HW, HI	.394	10.00	.040	1.01	.550	13.97	4,400	300	17,500	1,200	1.90	48.26	.220	.33
70-300-10-03-02	1/2 BB -10	MW, HI	.530	13.46	.030	0.76	.690	17.52	2,500	170	10,100	700	3.10	78.74	.240	.36
70-300-13-03-02	13/32 BB	HW, HI	.406	10.31	.040	1.01	.675	17.14	4,350	300	17,500	1,200	2.70	68.58	.235	.35

SPECIFICATIONS and SIZE RANGE FOR VERY HIGH PRESSURE HOSE (GRADE VHI)

*Part No.	Aflex Nominal Bore Size and 'dash' reference	Grade	Actual Bore Size		PTFE Tube Wall Thickness		Outside Diameter of Braid		Maximum Working Pressure (4:1 Safety)		Burst Pressure		Minimum Bend Radius		Weight per Metre	
			ins	mm	ins	mm	ins	mm	psi	bar	psi	bar	ins	mm	lbs per foot	kgs per metre
70-200-04-03-555502	1/4"	HW, VHI	.250	6.35	.040	1.01	0.475	12.00	8,000	550	32,000	2,200	1.28	30	.168	0.25
70-200-06-03-555502	3/8"	HW, VHI	.375	9.53	.040	1.01	0.673	17.10	8,000	550	32,000	2,200	1.57	40	.235	0.34
70-200-08-03-555502	1/2"	HW, VHI	.500	12.90	.040	1.01	0.777	19.75	6,000	410	24,000	1650	2.16	55	.268	0.40
70-200-12-03-555502	3/4"	HW, VHI	.750	19.05	.050	1.27	1.100	28.00	5,000	340	20,000	1380	4.72	120	.450	1.477

** For Anti-Static Grade, add 10 to the 3-digit part number e.g. 70-300 becomes 70-310.*
For High Pressure Gas Grade, add 20, e.g. 70-300- becomes 70-320-.

***Note**: Some of the sizes and grades of High Pressure Hose listed above are not available ex-stock, and are therefore only made to Special Order.*

Temperature & Pressure

- Temperature affects the Maximum Working Pressure (MWP) as listed above, so for temperatures above 130˚C reduce the MWP by 0.75% for each 1˚C above 130˚C. Example: at 180˚C, reduce the MWP by (180 - 130) x 0.75 = 37.5%.
- Pressure Ratings above 100 Bar (1500 psi) only apply for the transfer of non-penetrating fluids. If gases or penetrating fluids are used at higher pressures, HPG grade hose is required.
- Maximum Working Pressures (MWP) listed are calculated on the basis of a 4:1 safety factor relative to the burst pressure, so Burst Pressure = 4 x MWP. If MWP is required based on a 3:1 safety factor, multiply the listed pressure rating by 1.33.

Alternative PTFE Tube Liners

High Pressure Gas (HPG) and Antistatic (AS)

High Pressure Gas (HPG Grade) PTFE Tube Liners (Available to Special Order Only)

For applications where gases are used in the hose at high pressures, typically above 100 bar (1500 psi) it is necessary to specify an HPG grade PTFE liner tube. HPG grade is also required when high pressures are applied to “penetrating” fluids.

HPG grade tubing is acheived by subjecting the PTFE tube to certain special processes, commonly known as “post sintering”, which increases the resistance of the material to penetration and porosity development by gases in service.

HPG Liner

HPG Specification

This specification requires that when compressed air or nitrogen is applied to a sample length at a pressure of 275 Bar (4000 psi) for 1 minute, then the pressure rapidly broken then re-applied for a total of 10 cycles, the the sample must not show signs of excessive diffusion when finally gas tested under water.

Because pure gases do not generate static charges, HPG liners are rarely required to be antistatic, but on such rare occasions, a special “inner layer” AS grade is used as described at the bottom of this page.

Note: All sizes and types of Smoothbore Hose PTFE tube liners can be supplied to HPG quality. In practice, however, HPG hoses are nearly always HW (Heavy Wall) grade, in bore sizes from 6mm (1/4”) up to 10mm (3/8”).

Anti-Static (AS Grade) PTFE Tube Liners (Available to Special Order Only)

Purpose

An AS Grade PTFE tube liner is an essential requirement in applications where there is a risk of an electrostatic charge build-up on the inside surface of the PTFE tube which may then discharge through the tube wall. Media passing through which create such a risk are fluids which have a Conductance of less than 10^{-8} S/m (Siemens per Metre), or 10^{4} pS/m such as fuels, solvents, freons, some oils, some WFI (ultra-pure “Water for Injection”) and non-polar organics which are being transferred at a medium to high flow velocity (more than 2 mtrs/sec.)

AS Grade Liner

All twin or multi phase media, and any non-mixing media, such as powder in air, or water droplets in steam, in gases or in oil, also colloidal fluids constitute a particular hazard for static charge generation, and always require grade AS.

Design & Approval

Aflex Hose AS Grade PTFE tube liners are manufactured from FDA 21 CFR 177.1550 approved PTFE, and less than 2.5% of “high purity” Carbon Black material to FDA requirement 21 CFR 178.3297. The carbon is encapsulated by the PTFE, and in normal, non-abrasive applications will not come loose to contaminate any fluid passing through. Leachables and Extractables testing has confirmed that no loose carbon was found.

HPG/AS Grade Liner

HPG/AS Grade Liner

The carbon is mixed into the PTFE for the whole wall thickness of the tube, EXCEPT for rare applications where both HPG and AS are required. For such HPG/AS grade tubes, only an inner layer of the wall thickness is AS grade PTFE, with the outer layer in natural PTFE (see drawing).

Plastic or Rubber Hose Covers

ALTERNATIVE PTFE HOSE COVER DESIGN OPTIONS

Purpose

For many applications, it is required that Smoothbore PTFE hose of all sizes, grades and braids should have an outer cover of a flexible plastic, or rubber.

This is usually required to protect the braid, or to colour the hose, or to allow printing on to the hose.

Plastic Covers - available to special order

PVC - flexible PVC covers are the most popular, either transparent, or a wide range of solid or semi-transparent colours.

A particular application is for -3 size single braid, clear PVC covered hose, used as a brake hose for motorbikes, motorsport and special vehicles.

PVC covers are designated as “PVC” followed by the colour if a solid colour is required or “Trans” then the colour if a semi-transparent colour is required.

For example - “-3 HW, SB, PVC Blue” would call for a -3 heavy wall, single braid hose with a solid, blue PVC cover.

Nylon II (Nyl), Hytrel (Hyt), Sarlink (Sar) and other types of flexible thermoplastics are also widely used.

Text can be continuously printed along the hose length, usually in black.

Rubber Covers - available to Special Order

ZH-flex Hose also have rubber extrusion facilities, and can continuously extrude rubber covers on to all grades of hose.

EPDM rubber in blue (RC Blue) or black(antistatic) (RC Black), or platinum cured Silicone rubber in transparent (SI) or white (SI White) are available to special order. Other colours and types of rubber may also be available. Consult Aflex Hose for details.

“PRICKING” of Hose Covers

As a standard, PVC and Nylon II covers are NOT pricked. Hytrel, Sarlink and Rubber Covers ARE pricked.

If any variation to these standard rules are required, they must be specified.

Colour References

If a particular grade of one colour is required, a RAL Number or a colour reference sample is required.

Note: Coloured covers are to special order, and require a Set-Up Charge, so small quantities are usually not economic.

Limitations in Use - The application of a plastic or rubber cover limits the usage conditions of the hose, particularly the operating temperature ranges, as given below.

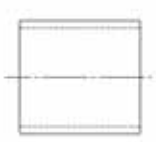
Flexible PVC from -10˚C (+14˚F) to +60˚C (+140˚F)
Nylon II from -40˚C (-40˚F) to +80˚C (+180˚F)
EPDM Rubber from -40˚C (-40˚F) to +140˚C (+280˚F)
Silicone Rubber from -55˚C (-67˚F) to +200˚C (+390˚F)

Smoothbore Hose End Fittings - PTFE Tail and Hydraulic Tail

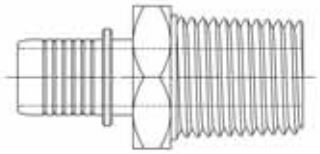
PTFE TAIL END FITTINGS FOR SW AND HW GRADES

ZH-flex Hose keep in stock a wide range of “PTFE-tail” design standard end fittings, ferrules and adaptors in both zinc plated carbon steel and 316L stainless steel.

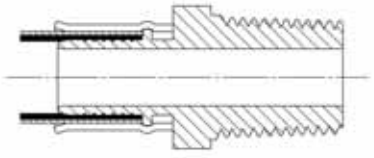
These are specified, with the relevant Aflex Hose Part Number, on Page 11.



Standard Tube Ferrule



Standard PTFE Tail BSPT Fixed Male Spigot



Crimped Fitting on Hose

PTFE-Tail End Fittings can only be applied to the Standard Smoothbore, Standard Wall (SW) and Heavy Wall (HW) Hose Grades.

HYDRAULIC-TAIL END FITTINGS FOR MW AND HI GRADES

These can only be used with the Standard Smoothbore, Medium Wall (MW) and the High Pressure (HI) Hose Grades.

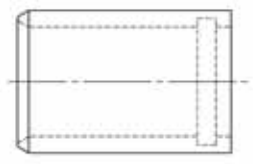
Hydraulic Tail end fittings are usually sourced from local Hydraulic Suppliers, but can be supplied by Aflex Hose if required.

Ferrules for MW, SB and MW, HI Hose can be supplied by Aflex Hose, as below.

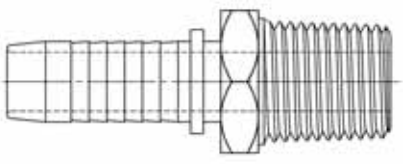
Ferrule Sizes and Part Numbers

MW, SB Hose	Zinc Plated Carbon Steel	Stainless Steel
3/16 BB -4	01-170-03-03-04	01-170-03-03-03
1/4 BB -5	01-170-04-04-04	01-170-04-04-03
5/16 BB -6	01-170-05-05-04	-
3/8 BB -8	01-170-06-06-04	01-170-06-06-03
1/2 BB -10	01-170-08-08-04	01-170-08-08-03
5/8 BB -12	01-170-10-10-04	01-170-10-10-03
3/4 BB	01-170-12-12-04	01-170-12-12-03
1 BB	01-170-16-16-04	01-170-16-16-03

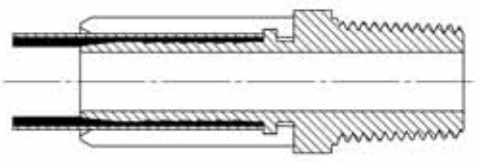
MW, HI Hose	Stainless Steel
3/16 BB -4	70-300-04-03-02
5/16 BB -6	70-300-06-03-02
3/8 BB -8	70-300-08-03-02
1/2 BB -10	70-300-10-03-02



Hydraulic Ferrule



Hydraulic Tail BSPT Fixed Male Spigot



Crimped Fitting on Hose

SPECIAL, LONG TAIL FITTINGS FOR VHI GRADE

The Very High Pressure (VHI) Grade hose requires special fittings with long tails and special ferrules, to ensure that the assembled fittings can withstand the very high burst pressures.

These fittings and ferrules are made and supplied to special order.

List of PTFE Tail End Fittings for Standard Smoothbore Hose Grades

Fitting Sizes, Types and Part Numbers

Hose Size and Grade	Fitting Material	Fixed Males		Fixed Female NPT	Cone Seat Female Union BSPP	Cone Seat Male-to-Male Adaptors	37° JIC Female Unions	JIC-to-NPT Male/Male Adaptors	Ferrules	
		BSPT 06-100-	NPT 06-110-	33-100-	07-500-	18-100-	07-597-	18-202-	For SB Hose 01-	For DB Hose 01-
-3 HW	SS MS	- 02-02-04	-	-	02-02-04	-	-	-	120-02-02-01 120-02-02-04	-
3/16" HW	SS MS	-	-	-	-	-	-	-	120-03-03-02 120-03-03-04	- 120-04-04-04
1/4" SW & HW	SS MS	04-04-01 04-04-04	04-04-01 -	04-04-01 -	04-04-01 04-04-04	04-04-01 04-04-04	07-04-01 -	07-04-01 -	120-04-04-02 120-04-04-04	125-04-04-02 *125-04-04-04
3/8" SW & HW	SS MS	06-06-01 06-06-04	06-06-01 -	06-06-01 -	06-06-01 06-06-04	06-06-01 06-06-04	09-06-01 -	09-06-01 -	120-06-06-02 120-06-06-04	180-06-06-02 170-06-06-04
1/2" SW & HW	SS MS	08-08-01 08-08-04	08-08-01 -	08-08-01 -	08-08-01 08-08-04	08-08-01 08-08-04	12-08-01 -	12-08-01 -	120-08-08-02 120-08-08-04	180-08-08-02 150-08-08-04
3/4" SW & HW	SS MS	12-12-01 12-12-04	12-12-01 -	12-12-01 -	12-12-01 12-12-04	12-12-01 12-012-04	17-12-01 -	17-12-01 -	240-12-12-02 120-12-12-04	240-12-12-02 180-12-12-04
1" SW & HW	SS MS	16-16-01 16-16-04	16-16-01 -	16-16-01 -	16-16-01 16-16-04	16-16-01 16-16-04	21-16-01 -	21-16-01 -	*120-16-16-01 120-16-16-04	180-16-16-02 180-16-16-04
1 1/4" HW	SS MS	20-20-01 -	20-20-01 -	-	20-20-01 -	-	-	-	-	150-20-20-02 150-20-20-04
1 1/2" HW	SS MS	24-24-01 -	24-24-01 -	-	24-24-01 -	-	30-24-01 -	20-24-01 -	-	150-24-24-02 150-24-24-04
2" HW	SS MS	32-32-01 -	32-32-01 -	-	32-32-01 -	-	-	-	-	150-32-32-02 150-32-32-04

* 1" Ferrules for HW, SB hose are 01-150-16-16-02 (and 04).

Example: Part Numbers for a 1/2" NPT Fixed Male in SS is 06-110-08-08-01.

Note: The last 2 digits of the Part Number indicates the material: 01=316 SS, 02 = 304 SS, 04 = Zinc Plated Carbon Steel.

Correct Hose Configuration & Length Calculations - for Bend Radius

Hose Configuration Requirements

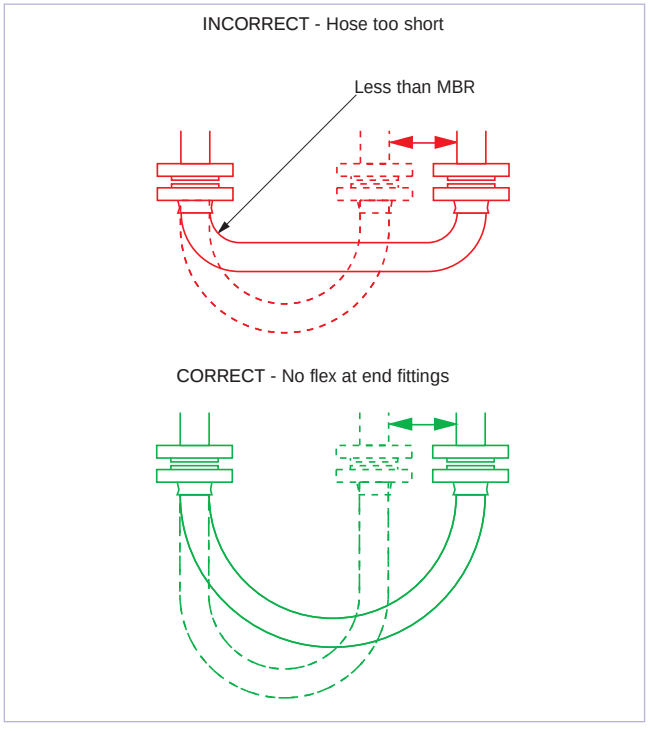
Hose Assemblies are usually connected at both ends in service. They may then either remain in a fixed, or static configuration or in a flexing, or dynamic configuration.

Whether static or dynamic, the First Rule concerning the configuration of the hose is that the bend radius of the hose must never be less than the Minimum Bend Radius (MBR) for the hose as listed in the relevant hose brochure.

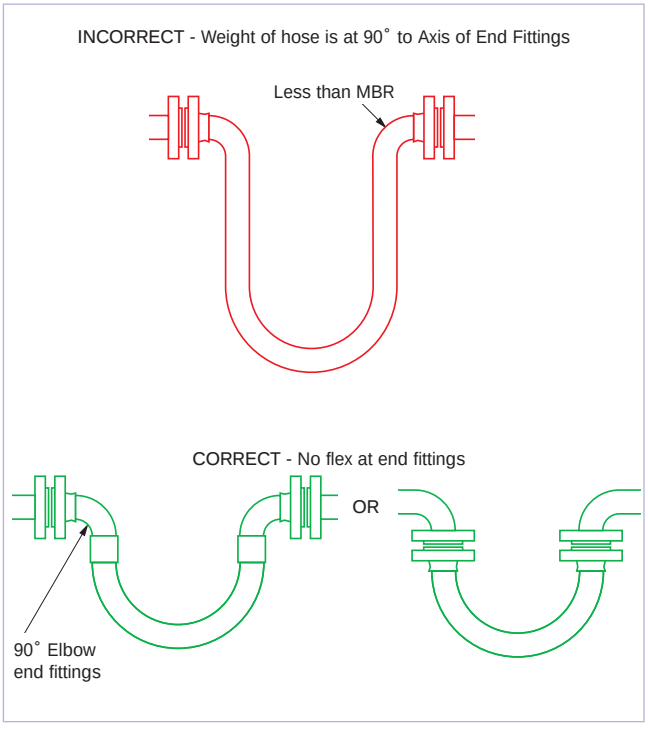
The most common situation when this is likely to occur is when the hose is flexed at the end fitting, with stress being applied to the hose at an angle to the axis of the end fitting. Typically, this happens either because the length of the hose is too short, or because the weight of the hose plus contents creates a stress at an angle to the end fitting.

The Second Rule, therefore, if possible, is to design the configuration to ensure that any flexing in the hose takes place away from the end fittings.

(Dynamic) Configuration



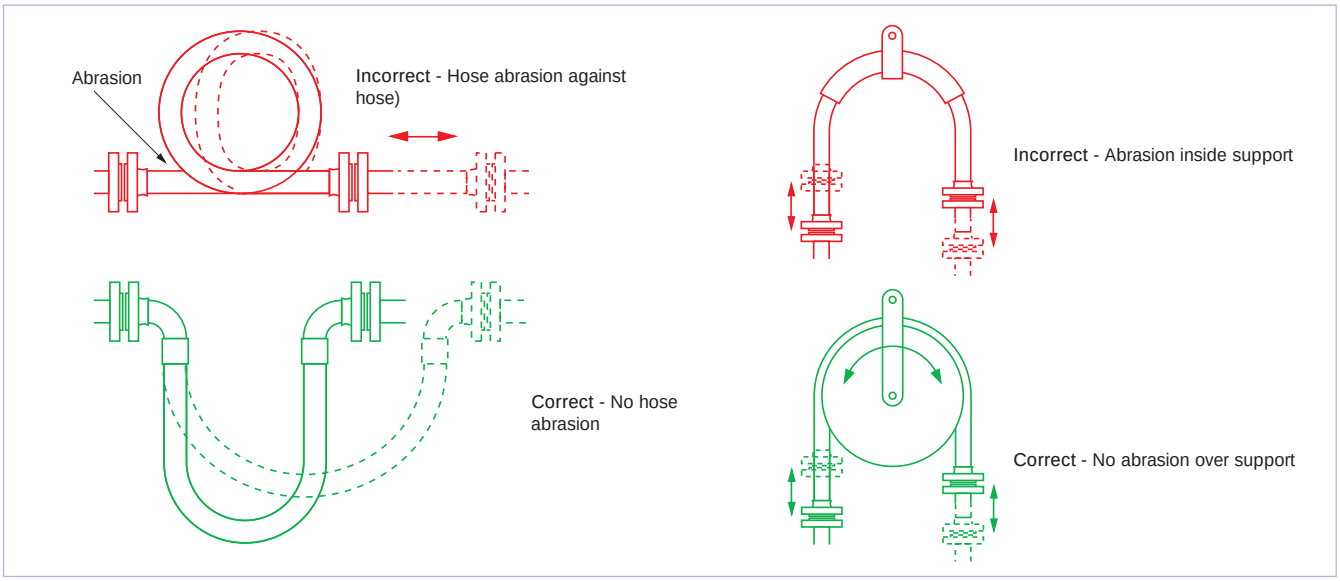
(Static) Configuration



Correct Hose Configuration & Length Calculations - for Abrasion & Torque

The Third Rule is that the hose configuration should always be designed, and supported where necessary, to avoid any possibility of external abrasion.

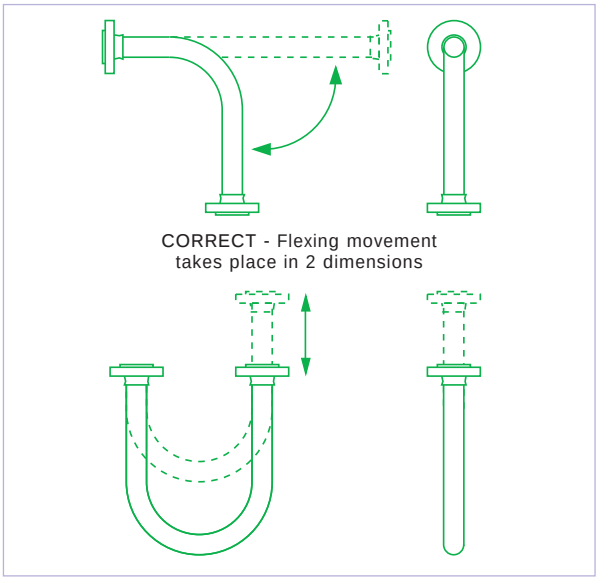
In some cases, the length, configuration and angle of the hose can be designed to avoid abrasion. In others, static or moving support frames or support wheels are required.

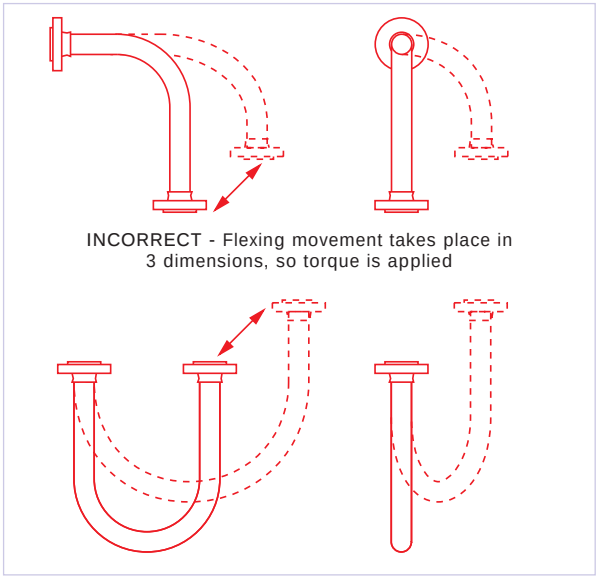


The Fourth Rule is that the hose must not be subjected to torque, either during connection, or as a result of the flexing cycle.

Torque (twist) in the hose can be applied during connection if the hose is accidentally twisted, or if the second end being connected is a screwed connection, and the hose is subjected to torque during final tightening.

In a flexing application, if any flexing cycle of the hose occurs in 3 dimensions instead of 2, then torque will also occur:





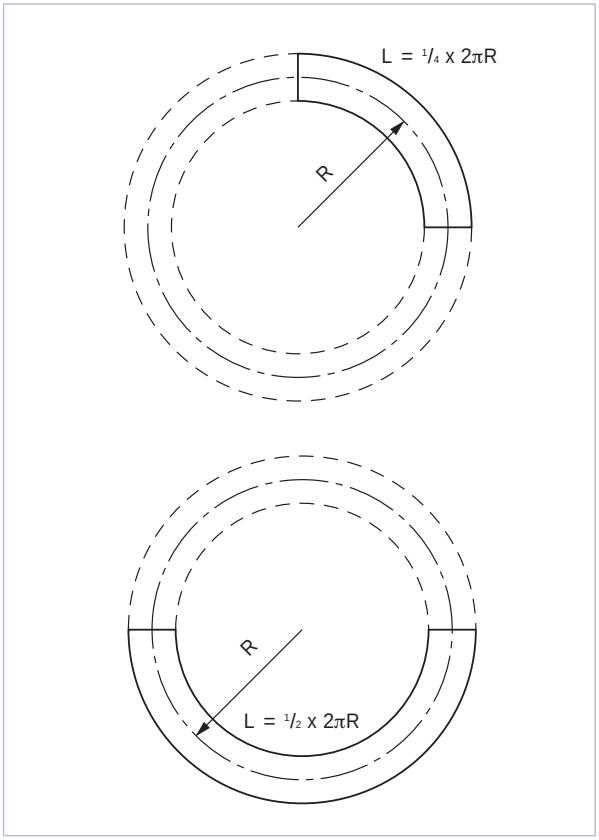
Both Corroflon and Bioflex hose have good resistance to a small level of torque, much better resistance that rubber or SS hose types, but it is still the best practice to take whatever steps are necessary to eliminate torque. If in doubt, consult Aflex Hose.

Hose Configurations & Length Calculations - for Length Calculation

CALCULATING THE HOSE LENGTH

The formula for calculating the bent section of the hose length around a radius is derived from the basic formula that the circumference of a circle = $2\pi R$, where R = the radius of the circle, and π = a constant, = 3.142.

So, if the hose goes around a 90˚ bend, which is $^1/4$ of a full circumference, and the radius of the bend is R, then the length of the hose around the bend is = $^1/4$ x $2\pi R$. Or half way round, in a U-shape, = $^1/2$ x $2\pi R$.



Note :
In calculating the length of a hose assembly, the (non-flexible) length of the end fittings must be added in, also the length of any straight sections of hose, as in the following example:

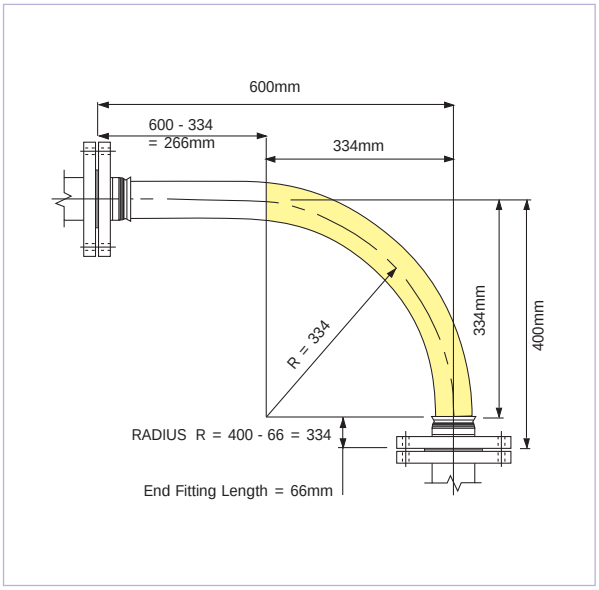
Example :
To calculate the length for a 2" bore size hose with flange end fittings, to be fitted in a 90˚ configuration with one leg 400mm long, the other 600mm long.

Length of Bent Section (yellow) = $^1/4$ x $2\pi R$ (334)
= $^1/4$ x 2 x 3.142 x 334 = 525mm

Length of top, Straight Section, including the top end fitting length
= 600 - 334 = 266mm

Length of bottom end fitting = 66mm

Total length of Hose Assembly = 525 + 266 + 66 = 857mm



Things to consider

(a) A hose will normally take the longest radius available to it to go around a corner, not the MBR! Also - always remember to include the non-flexible end fitting lengths.

(b) In dynamic applications, remember to always calculate the lengths for the most extended configuration during the flexing cycle, not the least extended.

(c) If the configuration is simply too complex for calculation, then obtain a length of flexible tubing of some kind, mark on paper, or a wall, or floor, or both where the connection points will be relative to each other, scaled down if necessary, then manually run the flexible tubing between them with full radii round bends. Measure the extended length, then scale up if necessary to determine the approximate length of the hose.

If in doubt, consult ZH-flex Hose.

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